Long-distance neuronal communication is accomplished by action potentials propagating along the axons of nerve cells. Extracellular nerve recordings have long been used to estimate properties of axons within nerves, including conduction velocity, ion current flow, and diameter. Action potentials are mediated through sodium and potassium conductances across the axonal membrane. Since axons with larger diameter possess larger currents, and these currents are picked up by extracellular recordings, action potential amplitude predicts diameter differences between axons projecting through the same nerve (diameter α $\sqrt[3]{amplitude^2}$). Sodium and potassium conductances, however, change non-linearly with environmental conditions, including temperature. **Given that ion channel temperature responses also differ between individual neurons, and the amplitudes of extracellularly recorded action potentials depend on ion current flow**, **we hypothesize that temperature will have distinct effects on the amplitude of action potentials from different neurons.** Thus, the original formula to infer relative size differences from the amplitude of an action potential may be more complex than previously thought. We will test this hypothesis using three distinct and individually identifiable axons in the crustacean stomatogastric nervous system. When measured extracellularly, their action potentials showed clear amplitude differences, indicating distinct axon diameters. Using voltage-sensitive dye imaging, we confirmed diameters were distinct, with the largest axon being 1.9 times larger than the smallest (n≥5). We are currently testing how action potential amplitude ratios change when these axons are subjected to temperatures changes (4-23°C). This will allow us to assess whether diameter estimates derived from action potential amplitudes are affected by temperature changes.

10 keywords: action potentials, ion channels, axons, amplitude, temperature, propagation, neurons, extracellular, voltage-sensitive dye, currents